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Building Institutions to Address Air Pollution in Developing Countries: The Cap and Trade Approach

by

Joe Kruger, Katherine Grover, and Jeremy Schreifels

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FOREWORD

This paper was prepared by Joe Kruger, Katherine Grover, and Jeremy Schreifels (U.S. Environmental Protection Agency) for the OECD Global Forum on Sustainable Development: Emissions Trading and Concerted Action on Tradeable Emissions Permits (CATEP) Country Forum, held at the OECD Headquarters in Paris on 17-18 March 2003. The aim of the Forum was to bring representatives from OECD and non-OECD country governments together with representatives from the research community, to identify and discuss key policy issues relating to greenhouse gas emissions trading and other project based mechanisms for GHG emission reduction, such as Joint Implementation and the Clean Development Mechanism. The Forum also aimed to promote dialogue between the various stakeholder groups, and discuss policy needs in the design and implementation of tradeable emissions schemes. Forum participants included representatives from OECD and non-OECD governments, as well as from the research community. Those from industry and other institutions involved with emissions trading, joint implementation and clean development mechanism projects such as the European Commission and the World Bank were also represented.

The OECD Global Forums are one of the two pillars of the new architecture of the Centre for Co-operation with Non-Members, agreed upon by the Committee on Co-operation with Non-Members. The Global Forum on Sustainable Development (GFSD) provides a mechanism for achieving the OECD Ministers' outreach objective and will complement other work on sustainable development. Within the organisational framework of OECD, the GFSD will aim to facilitate a constructive dialogue between non-member and OECD economies on key issues on the sustainable development agenda.

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The ideas expressed in the paper are those of the author and do not necessarily represent the views of the OECD or its Member Countries.

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1. INTRODUCTION: ADDRESSING AIR POLLUTION PROBLEMS WITH WEAK ENVIRONMENTAL INSTITUTIONS

There is growing interest in the use of market-based incentives, such as cap and trade, for addressing environmental problems in developing countries. These instruments have been used successfully in the United States to reduce sulphur dioxide (SO_2) and nitrogen oxides (NO_X) in a cost-effective manner. However, it remains a question whether cap and trade is an appropriate measure for use in developing countries.

Before considering the role of cap and trade in developing countries, it is necessary to look more closely at the environmental and institutional context of these countries. While in developed countries many indicators of pollution levels are improving, the horizon is not as bright in much of the developing world. Population growth, rapid industrialisation, and increasing urbanisation have resulted in severe air pollution.

The magnitude of the problem can be illustrated by looking at ambient concentrations of SO_2 and nitrous dioxide (NO_2) in numerous large cities of the developing world. As is illustrated in Figure 1, pollution levels in many of these cities exceed the World Health Organisation (WHO) guidelines[1].

In particular, the urban air pollution problem is growing as economic development drives increased combustion of fossil fuels for industrial processes and electricity consumption. Figure 2 illustrates how electricity use and industrial fuel consumption in developing countries have increased by 145% and 65%, respectively, between 1985 and 1999.

Facing the growing problem of deteriorating air quality, most developing countries have used regulatory measures with a long history in developed countries, such as emission concentration standards or mandates of certain control technologies (Hettige et al., 1996). Despite the existence of environmental regulations on paper, however, compliance at the source level and enforcement by government officials is often problematic. Some analysts have argued that the use of market-based environmental approaches is the answer to this dilemma. Advocates of market-based approaches in developing countries note that these instruments, such as emission taxes and tradable permits, have a variety of benefits, including increased economic efficiency; improved decentralised decision-making about control options; greater incentives for technological change; and lower overall compliance costs.

Finally, these advocates note that market-based instruments more readily accommodate economic growth and changing environmental objectives (Blackman and Harrington, 2000). Unlike command-and-control programs that may require the regulator to make significant regulatory modifications to accommodate economic, technological, or political changes, market-based approaches allow sources to develop source-specific abatement strategies and free regulators to focus on emission verification and program enforcement.

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[1] WHO annual mean guidelines for air quality standards are 50 micrograms per cubic meter for sulfur dioxide and 40 micrograms per cubic meter for nitrous dioxide.

Figure 1: Urban SO₂ and NO₂ Concentrations in Select Cities
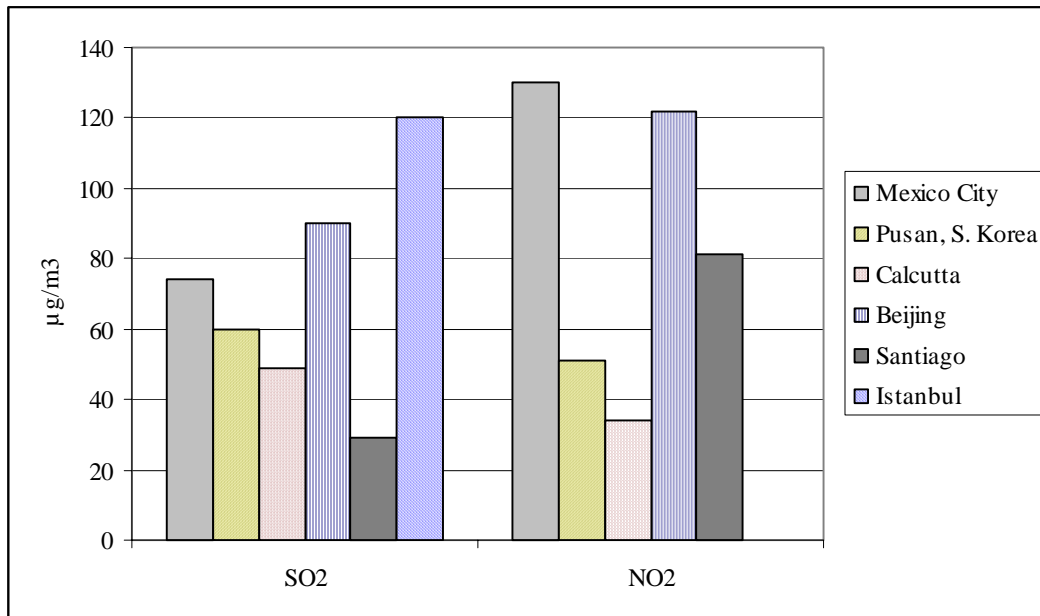
Source: World Bank, 1998

Figure 2: Electricity and Industrial Energy Consumption in Developing Countries 1985 – 1999
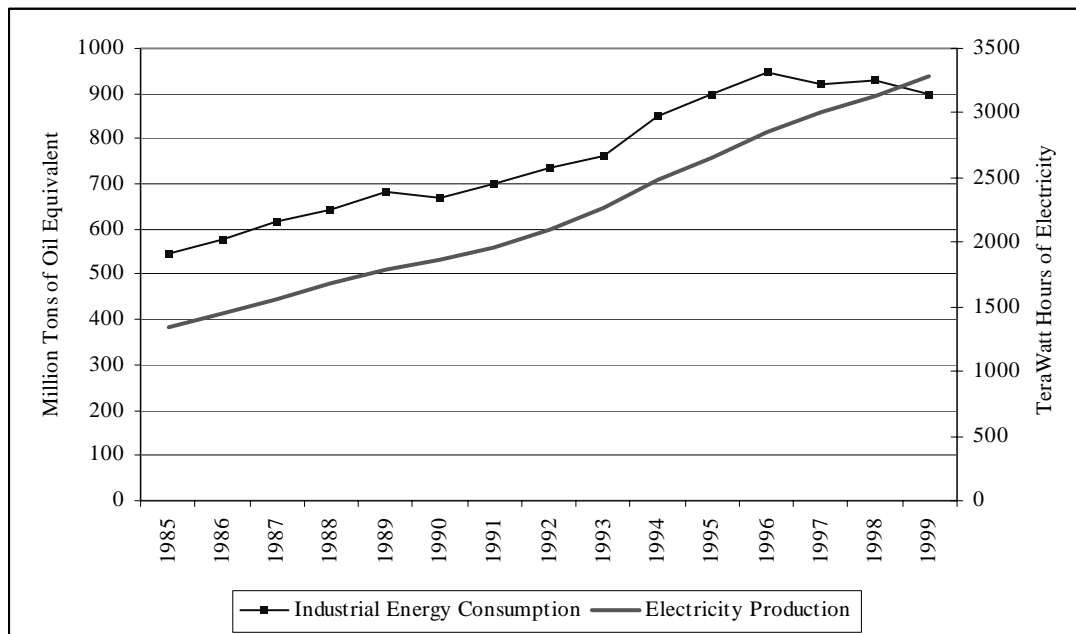
Source: IEA, 2001a; IEA, 2001b

Though some are enthusiastic about market-based instruments, other analysts have expressed some scepticism. These analysts assert that the pursuit of market-based policies in developing countries wastes valuable time and resources that could more effectively be directed to command-and-control programs. They maintain that developing countries lack the experience and institutions necessary to design and operate effective market-based policies (Bell and Russell, 2002; Russell and Vaughan, 2003).

Although both sides in this debate have some valid points, there are also flaws in each side's arguments. Some advocates of market-based programs gloss over critical institutional issues that can make or break successful environmental programs. The difficulties that developing countries, face in building effective environmental institutions of any kind are well known. These difficulties can include limited resources, lack of well-trained personnel, weak and unpredictable systems of environmental enforcement, lack of respect for the rule of law by industrial emitters, corruption, and even simple lack of equipment (Russell and Vaughan, 2003). Without tackling these difficulties, a market-based approach is no panacea for pollution problems.

On the other hand, while "market sceptics" correctly diagnose the problem, they often fail to offer concrete advice on what specific regulatory approaches would be more effective than market-based approaches. The challenge of developing successful environmental programs, market-based or not, is significant. However, there is little empirical evidence that the resources or expertise necessary to implement market-based programs, such as cap and trade, are greater than those for other types of environmental programs. Moreover, "market sceptics" tend to focus more on the "trade" aspects of emission trading and less on the attractive qualities of the compliance infrastructure necessary for achieving a cap on emissions. Even if there is no trading initially, cap and trade programs may still have some advantages over conventional regulatory approaches. Specifically, the compliance infrastructure needed for cap and trade may be both more effective and less resource intensive than the compliance infrastructure necessary to implement an effective command-and-control program.

Meanwhile, some developing countries are not waiting for the debate to be resolved. The desire to reconcile economic development with environmental improvement, combined with the well-documented success of the U.S. SO_2 allowance trading program (Ellerman et al., 2000; Burtraw, 1998; Stavins, 1998), has led some countries to show an interest in cap and trade. For example, China is actively pursuing numerous cap and trade pilots, Chile has implemented a cap and trade program in Santiago, and the Philippines included emission trading in recent amendments to the Filipino Clean Air Act.

Given the limited resources and often weak and ineffective government institutions in developing countries, is this the best direction for developing countries to be heading? The following sections identify problems faced by developing countries in implementing effective environmental programs, outline some of the potential benefits of cap and trade for these countries, and address concerns about whether cap and trade is an appropriate instrument. The paper concludes with recommendations for building the institutional capacity for effective cap and trade programs in developing countries.

2. ADDRESSING AIR POLLUTION PROBLEMS WITH CAP AND TRADE

Before making the case for cap and trade programs in developing countries, it is necessary to provide some background on how these programs work. Under a cap and trade program, policymakers establish a cap that limits total emissions from sources participating in the program. The cap is divided into allowances, each representing an authorisation to emit a specific quantity of pollution (e.g., one ton of SO_2), and distributed to emission sources. The sources are obliged to report their emissions and, at the end of the compliance period, surrender one allowance for each unit of pollution. The sources, however, have the flexibility to design a compliance strategy that accounts for their circumstances. A source may install control technologies, implement process changes, or switch fuels to reduce emissions. In addition, sources have the flexibility to buy or sell allowances to meet the program requirements. Those sources that reduce emissions more than required can sell surplus allowances to other sources. The revenue from allowance sales can offset the cost of emission reduction measures and provide a financial reward for better environmental performance. Sources with high costs to reduce emissions may purchase allowances from other sources at a lower cost, thus complying with the program requirements at a lower cost. Because total emissions are capped, proper program design and enforcement will maintain the emission goal.

Cap and trade is not appropriate for all environmental problems. Cap and trade can be an effective approach if the environmental problem meets several criteria. First, the problem is primarily regional or global in nature and the precise location of emission reductions will not hinder the ability to achieve the environmental goal. Second, there are technically and economically feasible means of measuring emissions from each source. Finally, the economic benefits of cap and trade programs arise when the costs of abating emissions vary from source to source (USEPA, 2003).

3. ADDRESSING CONCERNS ABOUT THE USE OF CAP AND TRADE IN DEVELOPING COUNTRIES

"Market sceptics" that assert developing countries are not prepared for cap and trade often cite three primary concerns:

- Accurate emission measurement is too difficult and too expensive;

- Developing countries lack the expertise to implement and enforce cap and trade programs; and

- Developing countries lack fully developed markets.

Each of these three concerns is discussed below.

3.1 Concern 1: Accurate emission measurement is too difficult and too expensive

Accurate measurement and consistent, credible enforcement are the foundation of an effective cap and trade program. Emission measurement is critical because it ensures the environmental integrity of the emission cap. Ultimately, the number of allowances an emission source must surrender to the regulator for compliance is determined by measured emissions. Moreover, since compliance costs are linked directly to total emissions, sources have an incentive to underestimate their own emissions. Accurate emission measurement is therefore the backbone of a cap and trade program, and ensuring that emission measurement is accurate is the fundamental government role in these programs.

Much of the scepticism about developing countries' ability to measure emissions focuses on the expense and technical challenges of using continuous emission monitors (CEMs) to measure emissions. Although CEMs may be the most accurate measurement method in many circumstances, and may be necessary if a source utilises post-combustion controls, different pollutants may permit alternative measurement methods. Emissions that are based on fuel composition can often be estimated using engineering calculations in lieu of CEMs. The mass-balance approach uses fuel composition and consumption data to calculate total emissions. It provides reasonably accurate estimates of total mass emissions over the entire compliance period, mitigating the "clean for a day" effect associated with periodic stack inspections where facilities modify processes, operate control equipment, and change fuels for the inspection period but revert back to the previous state after the inspection (Jahnke, 2000). To reduce opportunities for false reporting and improve verifiability, the regulator can collect supplemental information (e.g., fuel purchases, product output) and use this information to verify fuel consumption and compare emission intensity over time to look for unexpected values. Whatever measurement approach is used, policymakers, program participants, and other interested stakeholders must perceive the approach as fair and accurate (Drayton, 1978).

Developing a complete, accurate accounting of total mass emissions provides additional benefits beyond the enforcement of cap and trade programs. An emission inventory can help regulators determine the effectiveness of an environmental policy, improve air quality modelling efforts, and set more appropriate emission targets for applicable sources. In the Santiago, Chile total suspended particulate (TSP) trading program, the regulating authority developed an emission inventory for the purpose of allocating allowances in the cap and trade program. The identification and inspection of stationary sources provided the best accounting to date of stationary TSP sources in Santiago and it revealed important differences between the emission inventory and expected results (Montero et al., 2002).

Once emission data and supplemental information is collected, the regulator must track and manage the data. In larger programs this can be a significant undertaking requiring considerable resources. However, advances in information technology have made it easier and less expensive to use computerised tracking systems, or registries, to reduce the administrative burden. In the U.S. SO_2 cap and trade program, computerised tracking systems make it possible to collect, verify, manage, and disseminate emission data from more than 2,000 sources. Without such technologies it would be difficult if not impossible to ensure the accuracy of the more than four million hourly SO_2 emission measurements reported each quarter. Such systems can be implemented in developing countries at relatively low cost. For example, Resources for the Future, a U.S.-based NGO, developed emission and allowance registries capable of collecting and managing emission data, generating public reports, managing allowance transfers, and assessing compliance. The cost of building and implementing the system was less than U.S.$5,000. Other systems, such as the U.S. Environmental Protection Agency's generic Emission and Allowance Tracking System (EATS), can be employed at very low cost.

3.2 Concern 2: Developing countries lack the expertise to implement and enforce cap and trade programs

The environmental departments in developing countries are often understaffed, underfinanced, and lack public support (Blackman and Harrington, 2000). As a result, many environmental policies in developing countries have failed. Regardless of the type of policy chosen, these constraints will affect a policy's effectiveness. Given these constraints and history of limited success, some analysts argue that institutions are insufficient for all but the most simple command-and-control programs. However, many of the requirements for cap and trade programs are the same as those required for command and control. Each type of program requires regulators to promulgate rules, allocate the emission reduction burden to sources, determine the requirements to place on sources, and enforce compliance (Ellerman, 2001; USEPA, 2003).

More specifically, an emission trading program, like any other environmental program, requires certain capabilities of the governing institution and the regulated community in order to achieve environmental success. Those elements that are common among environmental programs include:

- Historic emission and air quality data to determine the extent of the problem and the sources and/or sectors that contribute to the problem.

- An understanding of the options and costs for reducing emissions. This understanding is necessary to determine what level of emission control is technically and economically feasible.

- Access to control technologies or practices to reduce emissions. If the regulated community cannot purchase, install, transition to, or operate the technologies or practices to reduce emissions, the environmental program will not succeed.

- Administrative and legal institutions with the legal authority, institutional capability, and culture to enforce environmental regulations. Sources need to be certain that the rules of the program will be applied equally and will not change without adequate process and notification.

- Senior government officials that are engaged and willing to champion the program. This support is instrumental in moving an environmental program from concept to regulation to implementation.

Although many elements are similar, it is useful to examine how expertise and institutions differ for cap and trade and conventional programs. Cap and trade programs focus most staff resources on measurement, reporting, and auditing of source specific mass emission data. The key to a cap and trade program is that emission measurements be as accurate and complete as possible and measurement methodologies be as consistent as possible. In the U.S. SO_2 program, approximately 75% of staff resources (approximately 75 people, including personnel in Regional EPA offices and State agencies) are focused on these activities (USEPA, 2003). In addition, cap and trade programs require administrative resources to manage allowance data and the transfer of allowances. In the U.S. SO_2 program, approximately two people handle these tasks.

Some market sceptics argue that a technology requirement is the appropriate first step towards regulation for developing countries. According to this view, it is relatively easy to tell if a technology is installed correctly and is operating effectively (Russell and Vaughan, 2003). Putting aside the cost of requiring standardised technology on all facilities, there are several problems with this argument. First, ensuring that control technology is properly installed is not a simple task for government officials. Power plants and industrial facilities often have significantly different configurations, and ensuring proper installation requires substantial engineering expertise. In addition, ensuring that control technology is turned on and is operating properly requires some form of periodic monitoring. Operating costs for many control technologies (e.g., flue gas desulphurisation) are not insignificant, and there may be a huge incentive to shut them off if there is not appropriate oversight of the technology's performance.

Second, the standard way that governments around the world enforce technology requirements is through a detailed permitting process. In most cases, sources submit detailed permit applications describing plant configurations, the proposed technology and its specifications, expected emissions and levels of operation, proposed expenditures, and other information. Government officials review this information for each facility and issue a detailed, legally enforceable permit. In some countries, significant changes at a facility require additional extensive submissions by industry and review by government officials (U.K. Environment Agency, 2000; USEPA, 2000).

Thus, for some types of sources, implementing cap and trade programs can be simpler than command and control. Focusing on measurement and tracking of emission data rather than on detailed, facility specific technology or compliance plans is arguably a more straightforward role for government officials because it removes them from facility specific decisions and focuses them on measuring results. Measurement expertise may be applicable to a wider variety of facilities than the detailed, facility specific knowledge required to review permits. Similarly, fine tuning measurement techniques to different plants usually requires less adjustment and variation than adapting control technologies to different plant configurations. Moreover, as noted above, conventional regulatory approaches still need some form of emission measurement, particularly if there are post combustion controls. The experience of the U.S. SO_2 cap and trade program has demonstrated that administration of a well-designed program can be simpler and less expensive than other types of effective environmental policies, including command-and-control policies (McLean, 1996).

Finally, another administrative advantage of cap and trade is that it provides little discretion for the regulator when determining whether a source is in compliance. The test is simple: does the source have sufficient allowances to cover emissions? Under command-and-control programs, equipment can break down or practices might not be followed, leaving the regulator to determine if the incidents are egregious enough to warrant non-compliance penalties. Reducing the discretion of regulators also reduces the opportunities for corruption – a major threat to development in general (Keefer and Knack 1997) that makes the design of policy instruments difficult (Sterner, 2003).

3.3 Concern 3: Developing countries lack fully developed markets

Critics of market-based approaches argue that operations managers at emission sources do not have sufficient understanding of how markets work and that developing countries do not have developed market institutions (Bell and Russell, 2002). It is true that for the trading part of a cap and trade program to work, a country must have some of the same institutions and incentives in place that are required for other types of markets. These include a developed system of private contracts and property rights, a private sector that makes business decisions based on the desire to lower costs and raise profits, and a government culture that will allow private businesses to make decisions with a minimum of intervention. The regulated community must have confidence that allowances, if not explicitly provided as a property right, will function similarly to property rights and not be confiscated by the government without warning or reason. Although the allowances in the U.S. SO_2 and OTC NO_X allowance trading programs are not property rights, they are treated as *de facto* property rights (Ellerman et al., 2000).

Focusing on the adequacy of a country's market institutions as the primary criterion for whether cap and trade is appropriate assumes the primary goal of a cap and trade program is trading. From an environmental perspective, it is the cap and its associated institutions (measurement, enforcement, data systems, etc.) that represent the most important components of cap and trade programs. Thus, even in developing countries where laws, institutions, and practices associated with market economies are not fully developed it may still be valuable to experiment with cap and trade. These countries may experience a transitional phase for cap and trade where there is initially very little trading. The extent of that phase and the ability to achieve economic efficiency from cap and trade will depend on the pace of more general

economic transformation (Ellerman, 2001). Even in the absence of trading, the flexibility for sources to develop compliance strategies that account for their circumstances and the limit on total emissions provided by cap and trade can form the foundation of a credible, more efficient environmental program. This flexibility can encourage innovation and competition among emission reduction approaches, thereby further reducing the costs of complying with the emission cap (Burtraw, 2000).

Other analysts argue that uncertainty (Hahn, 1989), transaction costs, imperfect information, and institutional rigidities can hinder market performance (Blackman and Harrington, 2000). However, even with high transaction costs and other market constraints, cap and trade can be more environmentally and cost effective than command and control. In some developing countries, the government may provide some market services to reduce transaction costs. For example, in Taiyuan, China, the government provides standard contracts to participants in the cap and trade program and helps match buyers and sellers.

In the long run, cap and trade may also address a chronic problem in developing countries – access to capital. Many environmental programs in developing countries fail because industries do not have access to capital or equipment necessary to reduce emissions. Without access, industries cannot reduce emissions and the government must decide whether to allow the source to operate in non-compliance, provide the source with financial grants or loans, or shut down the source. With emission trading, industries can use revenues from allowance sales as collateral to finance technologies or process changes. It may, however, require experience before financial institutions are comfortable granting loans for environmental projects on the basis of allowance revenues.

4. CONCLUSIONS AND RECOMMENDATIONS

No one should underestimate the challenges of designing successful environmental programs in developing countries. Many developing countries lack some of the prerequisites for effective environmental programs, such as credible enforcement authority and adequate resources and expertise to implement a program. Nevertheless, the departure point for this paper is that as countries develop and as controlled economies and political systems become more open, there will eventually be political will to impose real environmental requirements. If this does not occur, then neither market-based programs such as cap and trade nor more conventional regulatory programs will be adequate.

Thus, if one assumes that over time, developing countries will put resources and political will behind improving the environment, the critical question is: what institutions should they build over the coming years? We argue that where large stationary sources of air pollution contribute to regional pollution problems, the institutions associated with cap and trade can be good building blocks for a credible environmental program. This is true even if there is no actual trading of emissions or if the onset of trading is delayed until general market institutions develop in a country.

International capacity building efforts should focus on these building blocks, which include credible enforcement practices, good measurement and tracking of mass emissions, economic and air quality models which allow for good environmental decisions about where to set the cap, and education. These key elements are elaborated below:

- **Emission measurement and reporting:** Capacity building should focus on the compliance structure necessary for mass emission accounting. Good emission measurement and reporting are essential building blocks to whatever approach developing countries implement, including cap and trade, emission taxes or fees, and command and control.

- Where possible, standardised protocols should be developed that can be adapted and made more specific to address national circumstances. Standardised emission measurement protocols have been developed for greenhouse gas accounting, and similar protocols could be developed for conventional pollutants. Funding institutions might also consider providing ongoing financial support for emission data collection activities, a move that would raise the importance and visibility of local staff that conduct these activities.

- **Data systems:** Information technologies are critical for cap and trade programs and can provide easy access to data that could be useful for compliance purposes in many forms of environmental programs. In addition to the obvious benefits for cap and trade, data systems can increase data accuracy, improve transparency, enhance public access to data, improve consistency and comparability of emission data, and build credibility in the environmental program (USEPA, 2003). Data systems can improve the management and enforcement of an environmental program, regardless of whether it is cap and trade or command and control.

  Although data systems development can be a significant start-up cost for cap and trade programs, standardised data systems for tracking emissions and allowances could be used to reduce the costs of setting up cap and trade programs in developing countries. Systems such as EPA's

Emission and Allowance Tracking System (EATS) can be adapted at relatively low cost to meet the needs of new cap and trade programs.

- **Modelling capability:** Models that project emissions, costs, and air quality impacts are important for making decisions on air pollution policies such as where to set an emission cap and which emission sources to include in an environmental program. Building this analytical capability within countries will provide them with the tools to design and more fully understand cap and trade as well as other environmental programs.

- **Enforcement:** Training, capacity building, and technical assistance on enforcement techniques is a critical aspect of building confidence in any new environmental initiative in developing countries. In some cases, modification of existing environmental laws may be necessary to provide adequate enforcement authority. Technical assistance may also be helpful in establishing appropriate penalty levels. Cap and trade programs require explicit consideration of how high to set penalties based on the marginal costs associated with reaching different emission levels.

- **Education:** Many environmental professionals, particularly at the local level, do not have adequate access to education and information. Yet, studies have shown that education and technical assistance can dramatically increase compliance with environmental programs (Dasgupta, 1999). Developing education materials for government, industry, and the public can improve the understanding of cap and trade and emphasise the institutional capacities necessary to effectively operate and participate in a cap and trade program.

Emission trading has attracted worldwide attention, due to the success of programs such as the U.S. SO_2 cap and trade program. Although the prospects of reduced environmental costs may make developing countries take notice, it is important for advocates of emission trading to acknowledge that the institutions discussed above need to be in place to make emission trading credible. We believe that the prospect of helping to reconcile economic growth with environmental protection will lead governments to develop the accountable and transparent institutions necessary for effective environmental programs. Our hope is that cap and trade programs can become one of the organising principles behind efforts to build capacity for effective environmental institutions.

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